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(54) Incubators.

(57) Incubators comprise a housing in which access apertures are provided through which access can be made to the interior of the incubator. Normally, each access aperture is closed by a door which is individually operated to open and close it. This necessitates means for coordinating the opening and closing of each door so that the correct conditions are maintained within the housing. Described herein is a housing (12) with access apertures (16, 18, 20) and doors (60, 62, 64), and a single mechanism (80, 82) for operating the doors (60, 62, 64). The mechanism comprises a cam (80), a cam track (82), and a cam follower mounted on each door (60, 62, 64) and which follows the track (82). Rotation of the cam (80) and its track (82) causes each door (60, 62, 64) to be openable in turn.

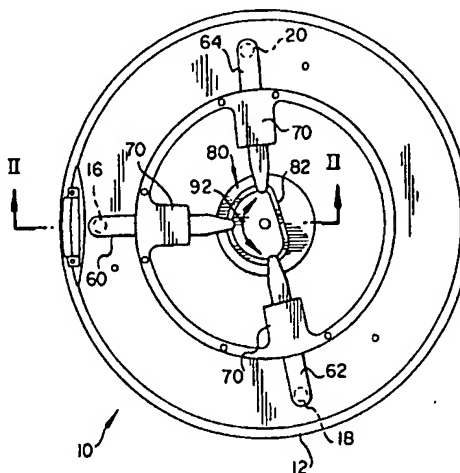


FIG. 1

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This invention relates to incubators and is more particularly concerned with a mechanism for controlling access to an incubator, preferably by a single drive means.

It is conventional in incubators for analyzers, to provide access apertures, for example, in the top thereof, for accessing the interior of the incubators for whatever function is needed. Doors are commonly mounted, one for each aperture, with activation means for opening and closing the access aperture. For example, in the incubators described in Japanese Kokai 61/209341, an access aperture in the top of the housing is closed and opened by a door which is pivoted by a motor. Thus, for each such aperture, a separate door and a separate means for operating the door are provided. The doors are normally closed to control the environment of the incubator.

Instead of having separate drive means for each of the doors, and a timing program to coordinate such plural drive means, it would be advantageous to have a driving mechanism which will automatically drive all the doors from a single motor.

It is therefore an object of the present invention to provide a solution to the problem of having one motor drive plural incubator doors at different locations.

More specifically, in accordance with one aspect of the present invention, there is provided an incubator comprising:-

- a plurality of stations each constructed to hold an assay for incubation at a controlled temperature,
- a housing enclosing the stations,

- temperature adjusting means for adjusting the temperature within the housing,

- at least one aperture in the housing for providing access to the stations, and

- door means for opening and closing each at least one aperture automatically in response to a signal, the door means including a movable door for each aperture;

- characterized in that the door means further comprise a cam, a cam follower on each door which engages the cam, and drive means for rotating the cam about an axis in response to a signal to cause a door to open or close its respective aperture.

Accordingly, it is an advantageous feature of the invention that all the doors of the incubator are operated by a single drive motor, preferably by a simple mechanical linkage using a cam.

For a better understanding of the present invention, reference will now be made, by way of example only, to the accompanying drawings in which:-

Figure 1 is a plan view of an incubator housing showing doors constructed in accordance with

the present invention;

Figure 2 is a fragmentary sectioned view taken generally along the line II - II of Figure 1;

Figure 3 is a fragmentary sectioned view taken generally along the line III - III of Figure 2; and

Figure 4 is a fragmentary plan view similar to that shown in Figure 1, but showing one of the three doors in its open position.

The invention is hereinafter described in connection with the preferred embodiments, in which the incubator has three doors which cover access apertures for cuvette injection, patient sample injection, and reagent injection, for a wet assay processed in a single rotor. In addition, the invention is useful regardless of the number of doors involved, of what is injected into the incubator when a door is open, and regardless of whether it is a liquid assay or a dry slide element assay or the number of rotors present.

As shown in Figures 1 and 2, an incubator 10 in a clinical analyzer comprises a housing 12 on a floor 14, Figure 2, the housing 12 having as is conventional several access apertures 16, 18 and 20, Figure 1, preferably provided in the top surface of the incubator housing. (Alternatively they can be located elsewhere.) Also as is conventional, incubator 10 includes heating elements 22, as shown in Figure 2, and a temperature sensor, for example, thermistor 24, to sense and control the temperature of the incubator, and a rotor 30 for holding patient sample and reagents for incubation.

Preferably, the assay is a wet assay, so that rotor 30 has slots 32, Figure 3, to accommodate cuvettes C on rails 34, the slots opening inwardly, Figure 2, for example, to allow movement of cuvettes C off the rotor, by a mechanism not shown. Rotor 30 is mounted for rotation by any suitable mechanism, for example, bearings 36, Figure 2, a rack gear 40 being provided on the outside of the rotor for engagement by a drive mechanism, for example, pinion gear 42 as shown (or a toothed belt drive).

Preferably, access aperture 16 is used to drop in individual cuvettes "C", as shown by arrow 50 in Figure 2, whereas aperture 18 is used to add patient sample and aperture 20 to add reagent, in both cases by the use of two different aspirate and dispense devices (not shown and conventional). Each aperture is disposed so that it is vertically above where a cuvette C is located by rotor 30.

To help control the environment of incubator 10, a door 60, 62 and 64 is provided for respective ones of apertures 16, 18 and 20, Figure 1. Most preferably, the doors are mounted for reciprocation in door frames 70, Figure 3. Alternatively, other mechanisms can be used to slide the doors within a frame.

In accordance with the invention, the operation and control of any one door, and preferably all of them together, is via a mechanical linkage comprising a cam 80, Figure 1, having a cam track 82 and a cam follower 84 on each door that engages track 82, Figure 2. Cam 80 is mounted on a drive shaft 86 which is preferably centered on the cam at its axis 88, and shaft 86 is in turn operated by a conventional motor 90 in accordance with commands from a computer (not shown). Because track 82 is eccentric with respect to axis 88, rotation of cam 80, as shown by arrow 92 in Figure 1, induces the doors to individually open and close by sliding within the frame. For example, when cam 80 is in the position shown in Figure 4, only door 62 advances towards axis 88 so that aperture 18 is opened, as shown by arrow 100, to allow patient sample to be injected into a cuvette which is underneath aperture 18. Further rotation in the direction of arrow 110 will open door 60 while door 62 is open, and then door 62 shuts. Still further rotation opens door 64, and further rotation closes door 60. Finally, door 64 shuts when track 82 is back in the position shown in Figure 1.

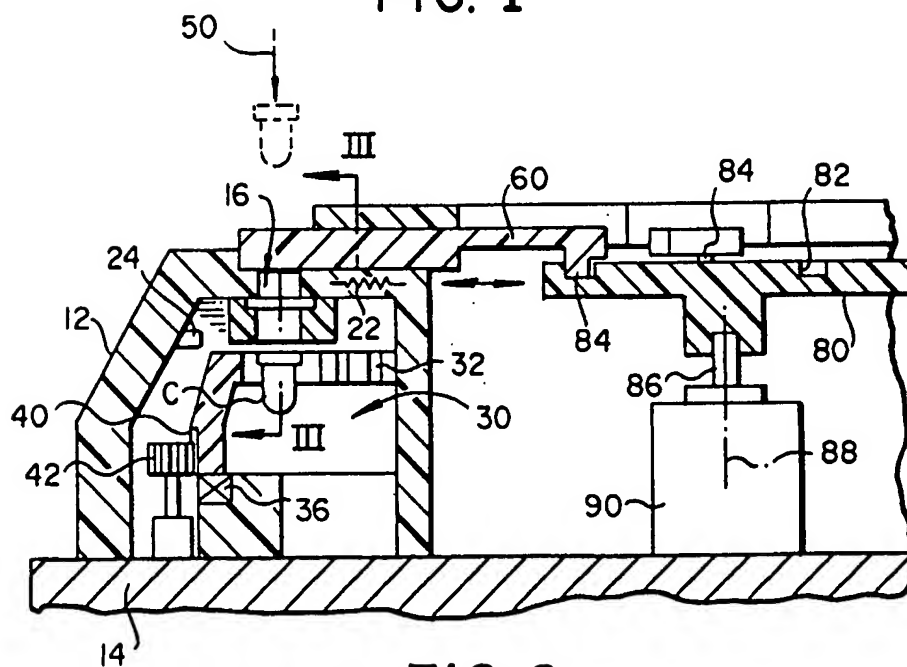
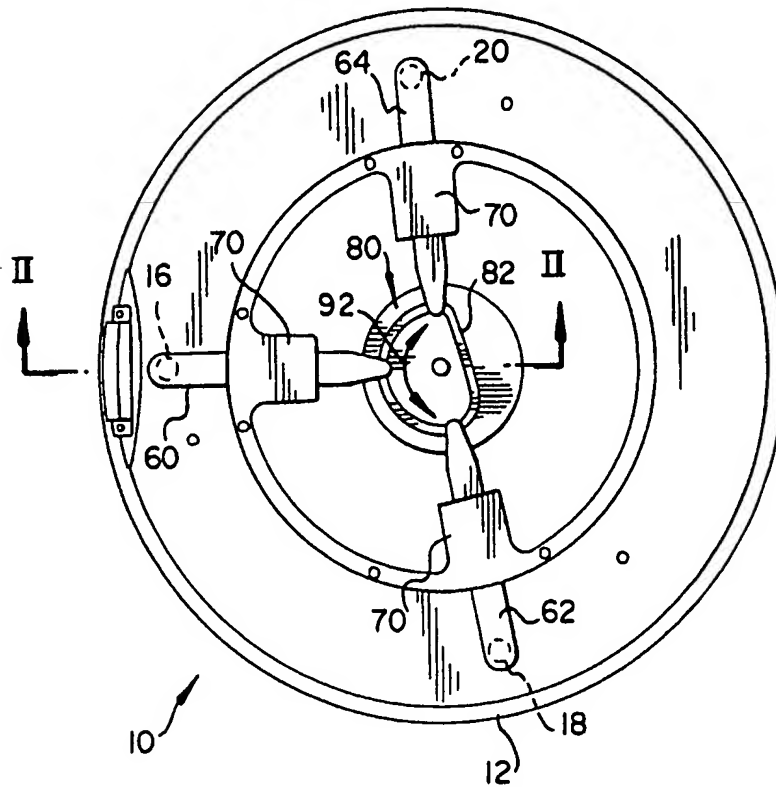
The invention disclosed herein may be practised in the absence of any element which is not specifically disclosed herein.

Claims

1. An incubator (10) comprising:-
 - a plurality of stations each constructed to hold an assay for incubation at a controlled temperature,
 - a housing (12, 14) enclosing the stations,
 - temperature adjusting means (22, 24) for adjusting the temperature within the housing (12, 14),
 - at least one aperture (16, 18, 20) in the housing (12, 14) for providing access to the stations, and
 - door means (60, 62, 64, 70, 80, 82, 84, 86, 88) for opening and closing each at least one aperture (16, 18, 20) automatically in response to a signal, the door means (60, 62, 64, 70, 80, 82, 84, 86, 88) including a movable door (60, 62, 64) for each aperture (16, 18, 20);
 - characterized in that the door means (60, 62, 64, 70, 80, 82, 84, 86, 88) further comprise a cam (80, 82), a cam follower (84) on each door (60, 62, 64) which engages the cam (80), and drive means (86) for rotating the cam (80, 82) about an axis (88) in response to a signal to cause a door (60, 62, 64) to open or close its respective aperture (16, 18, 20).
2. An incubator according to claim 1, wherein the housing (12, 14) further includes guide means

(70) for causing each door (60, 62, 64) to slide relative to its aperture (16, 18, 20) to close or open it.

3. An incubator according to claim 1 or 2, wherein a plurality of apertures (16, 18, 20) are provided in the housing (12, 14) and the cam (80, 82) includes a cam track (82) in which the cam followers (84) on the doors (60, 62, 64) are disposed, the track (82) being constructed along a path which is eccentric with respect to the axis (88).
4. An incubator according to claim 3, wherein the track (82) is constructed to allow only one of each of the apertures (16, 18, 20) to be open by the doors (60, 62, 64) at any one time.



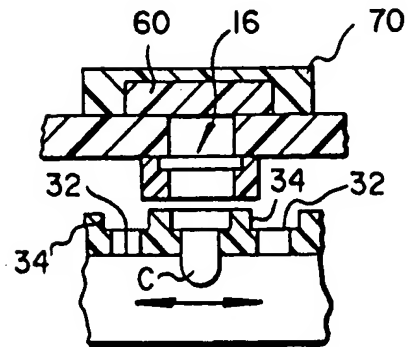


FIG. 3

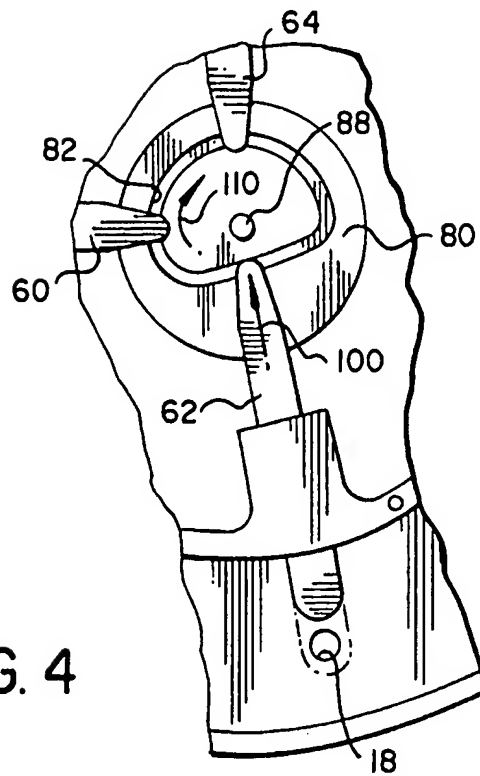


FIG. 4

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EUROPEAN SEARCH REPORT

Application Number

EP 93 20 1395

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.5)
A	US-A-5 049 359 (AZUMA ET AL.) * column 6, line 25 - line 43; figure 10 *	1	G01N35/02
A	EP-A-0 377 505 (EASTMAN KODAK) * column 4, line 32 - column 5, line 31 *	1	
A	AU-D-1 684 670 (BUTLER ET AL.) * page 12, line 18 - page 13, line 13 *	1	
A	EP-A-0 410 645 (TECHNICON INSTRUMENTS ET AL.) * page 11, line 42 - page 12, line 3; figure 13 * * page 13, line 18 - line 42; figures 21-24 *	1	
			TECHNICAL FIELDS SEARCHED (Int. Cl.5)
			G01N
The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 15 SEPTEMBER 1993	Examiner BINDON C.A.
<p>CATEGORY OF CITED DOCUMENTS</p> <p>X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document</p> <p>I : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons</p> <p>* : member of the same patent family, corresponding document</p>			